

SIGNALS AND MATING BEHAVIOR IN SEVERAL FIREFLIES (COLEOPTERA: LAMPYRIDAE)^{1, 2}

By JAMES E. LLOYD^{3, 4}

During the summers of 1963-65 while investigating flash communication in *Photinus* fireflies (Lloyd, 1966), I also studied several species in six other genera. Some of these observations have already been reported (Lloyd, 1965a, b). This paper presents data on other species. Recording and field techniques have been described in detail elsewhere (Lloyd, 1966). Distribution maps are given for each species where possible, as it is essential to correlate behavior with geographic distribution.

Lampyris (= *Pleotomodes*) *knulli* (Green)

Few lampyrid beetles described from North America are rarer than this Florida species (Map 3). Probably no more than two dozen are in collections, and until these observations females had not been found, or at least had not been recognized as *knulli* females. During May 1964 and 1965, five females were collected at the same site at Gainesville, Florida, and observations were made on their behavior.

Observation dates were between 2 and 16 May. Females were found glowing along a mowed roadside adjacent to a mesic woods. Their glows, visible at distances of 3 or more meters, appeared bright green. Captive females were placed in the site in open plastic boxes (8x8x3 cm). They began glowing 28-37 minutes after sunset and stopped glowing 60-68 minutes after sunset. Prior to glowing each evening they crawled from beneath the grass in their cages and exposed themselves in open areas or on perches. After each glowing period they retreated to cover. On May 4, 1965, midway through the normal glow period one female stopped glowing; investigation disclosed she had attracted a male and was mating with him. On May 8 a free female was seen glowing, but before she could be reached she dimmed and then extinguished her light. She was found mating with a male.

Males have a small luminous area on the ventral surface of the abdomen. None were seen glowing in nature even though over 40 nights were spent working in the site where females were found. When chemically stimulated (ethyl acetate, see Seliger et al. 1964) one male glowed from this light organ (J. Buck, personal comm.).

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³ Present address, Dept. of Entomology, University of Florida, Gainesville, Florida.

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Micronaspis floridana Green

For the distribution of this rare species see Map 4. Two males were collected at Coconut Grove, Florida, May 15, 1965. They were found within 100 meters of the ocean flying among low weeds and frequently being blown to the ground by the moderate wind. They emitted single flashes, estimated to be 0.13-0.18 seconds in duration (estimated by comparison with flashes of known duration produced by an electronic flasher (see Lloyd, 1966) at one second intervals (78°F.)).

Pyractomena borealis (Randall)

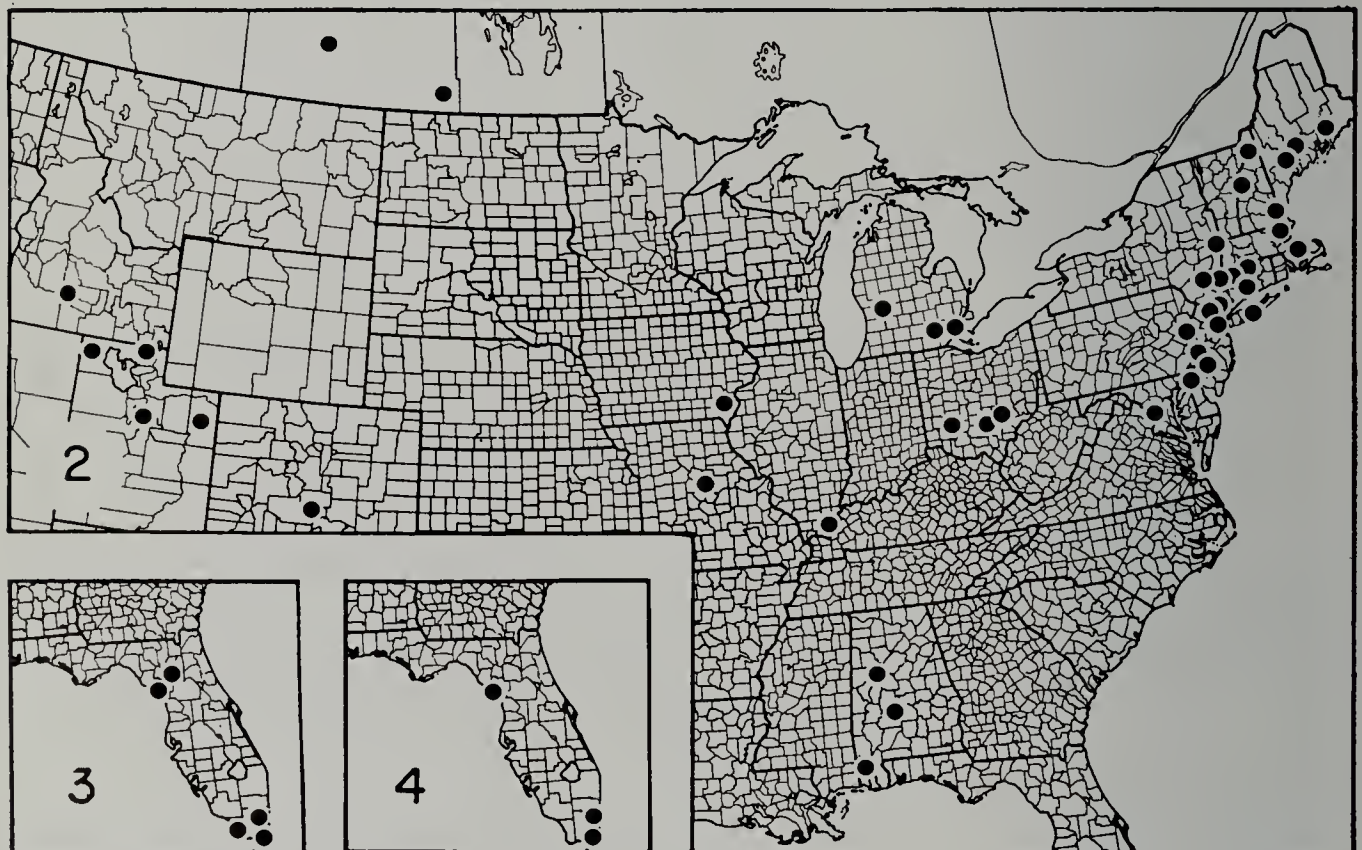
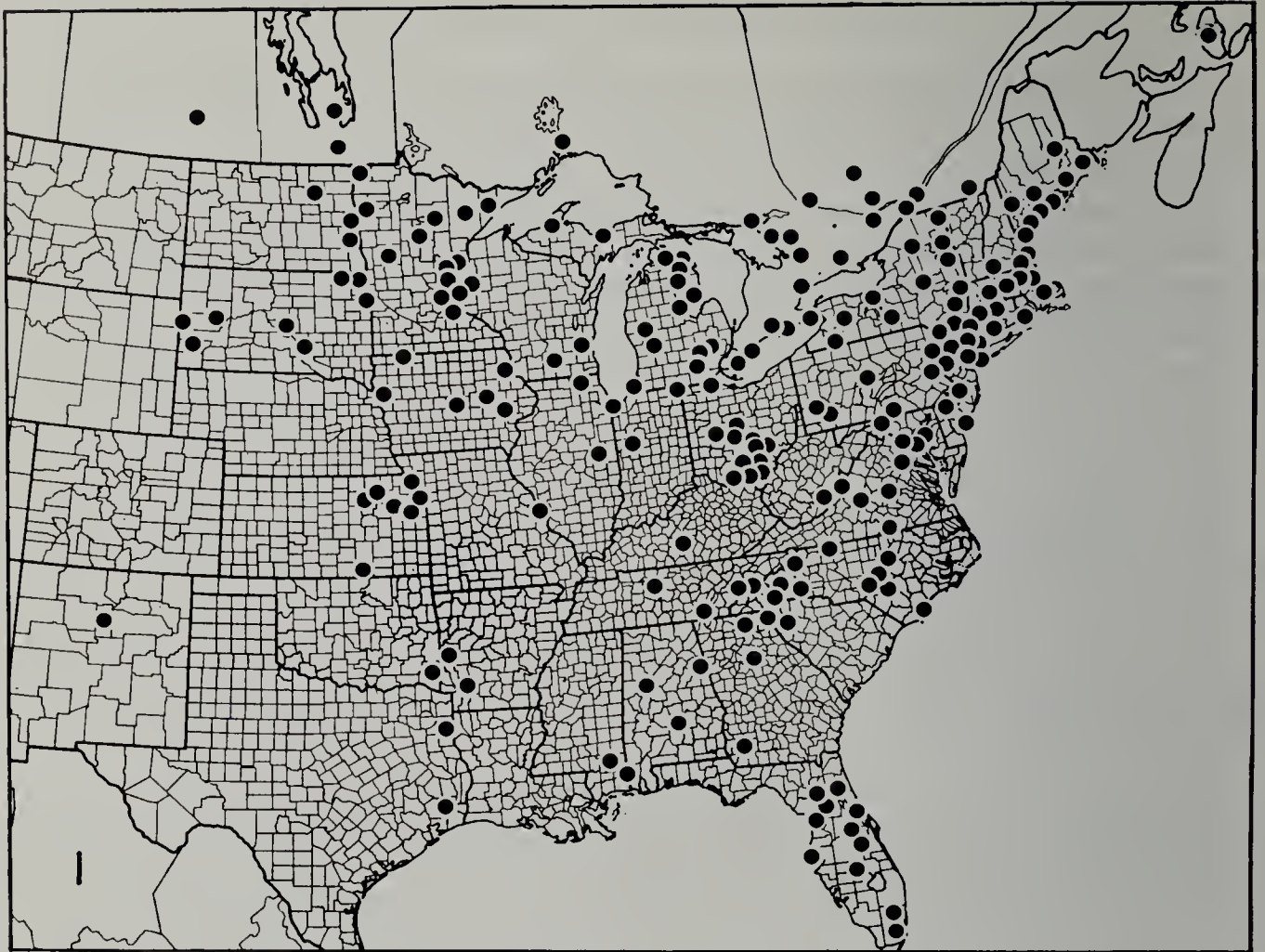
For distribution see Map 5. My observations are in agreement with those of McDermott (1917). This species was found in a mesic woods in Gainesville, Florida, and in a stand of red maple 4.3 miles west of Otter Creek, Florida, from February 28 to March 2, 1965. Moderately large populations were seen, suggesting that this is a cold-weather (in Florida a winter-adapted) species.

Flashing activity began about 32 minutes after sunset and lasted for approximately 50 minutes. Males flew among the leafless branches 2-8 meters above the ground. Their flash-pattern was a single flash estimated to be 0.30-0.35 seconds in duration at 50° and 0.20-0.25 seconds at 65°. They flew slowly, traversing 1-2 meters between flash-patterns and 4-10 centimeters during each pulse. Two males emitted the double flash described by McDermott; a normal flash followed by a less intense after-flash of approximately the same duration as the first. The pulse interval (time duration between beginning of first pulse and beginning of second pulse) of these two flashes in one male measured 0.6 seconds (stop watch) at 65°. Mean flash-pattern interval at 68° was 3.6 seconds and varied inversely with temperature; $\bar{x} = 4.2$ (65°) and $\bar{x} = 8.4$ seconds (50°).

Three females were collected. These were 2, 4, and 6 meters above the ground on tree trunks. Another answered the flashlight from a perch over 10 meters above the ground. They responded to male, flashlight, and electronic-flasher flashes with single pulses at slight time delays. Delays of two females measured with stop watch at 65° averaged 1.0 seconds. The response flashes of one female were analyzed by means of a portable transducer: her flashes turned on an audio oscillator, and the resulting tone was recorded on tape and later analyzed with an oscilloscope (see Lloyd, 1966). Her mean pulse length at 67° was 0.56 seconds (range 0.49), mean delay time (beginning of male pulse to beginning of response pulse) was 0.69 seconds (range 0.09).

Several males were attracted to caged females and to the flashlight when it was flashed in a manner simulating female responses in length and delay. One approach to a free female was observed; after four flash exchanges the male was on the tree beside her.

One important difference was noted between the approaches of males of this species and males of *Pyractomena dispersa* Green. *P. borealis* males approach females as do *Photinus* males; they remain in flight after each



MAP 1. Distribution of *Pyractomena angulata* (Say).

MAP 2. Distribution of *Pyractomena dispersa* Green.

MAP. 3. Distribution of *Lampyris* (= *Pleotomodes*) *knulli* (Green).

MAP 4. Distribution of *Micronaspis floridana* Green.

exchange, not landing until very near the female. *P. dispersa* males drop to the ground immediately after the first exchange and do not flash for a minute or more (Lloyd, 1964). This is obviously out of the question for *borealis*, an "upper story" species.

Pyractomena dispersa Green

For distribution see Map 2. Since the behavior of this species was described (Lloyd, 1964), additional observations have been made. Previously, males were not attracted to the flashlight.

Males were seen flying at Durham, Pennsylvania, June 8, 1963, over a field adjacent to a small stream. Several were attracted with 4- or 5-pulsed flashes, similar to those described for females. They were also attracted to 2-pulse flashes. For attraction it was necessary for the flashlight to be flashed from a position in front of and below them. Immediately after the flashlight response males dropped to the ground. A minute or more passed before their next flash-pattern.

Pyractomena marginalis Green

For distribution see Map 6. This species was seen in Lake Lure, North Carolina, June 24, 1963, in a grassy grove adjacent to a stream. A few males were observed flying about 40 minutes after sunset. They flew within 2 meters of the ground, emitting single short flashes at 5-7 seconds intervals at 65°.

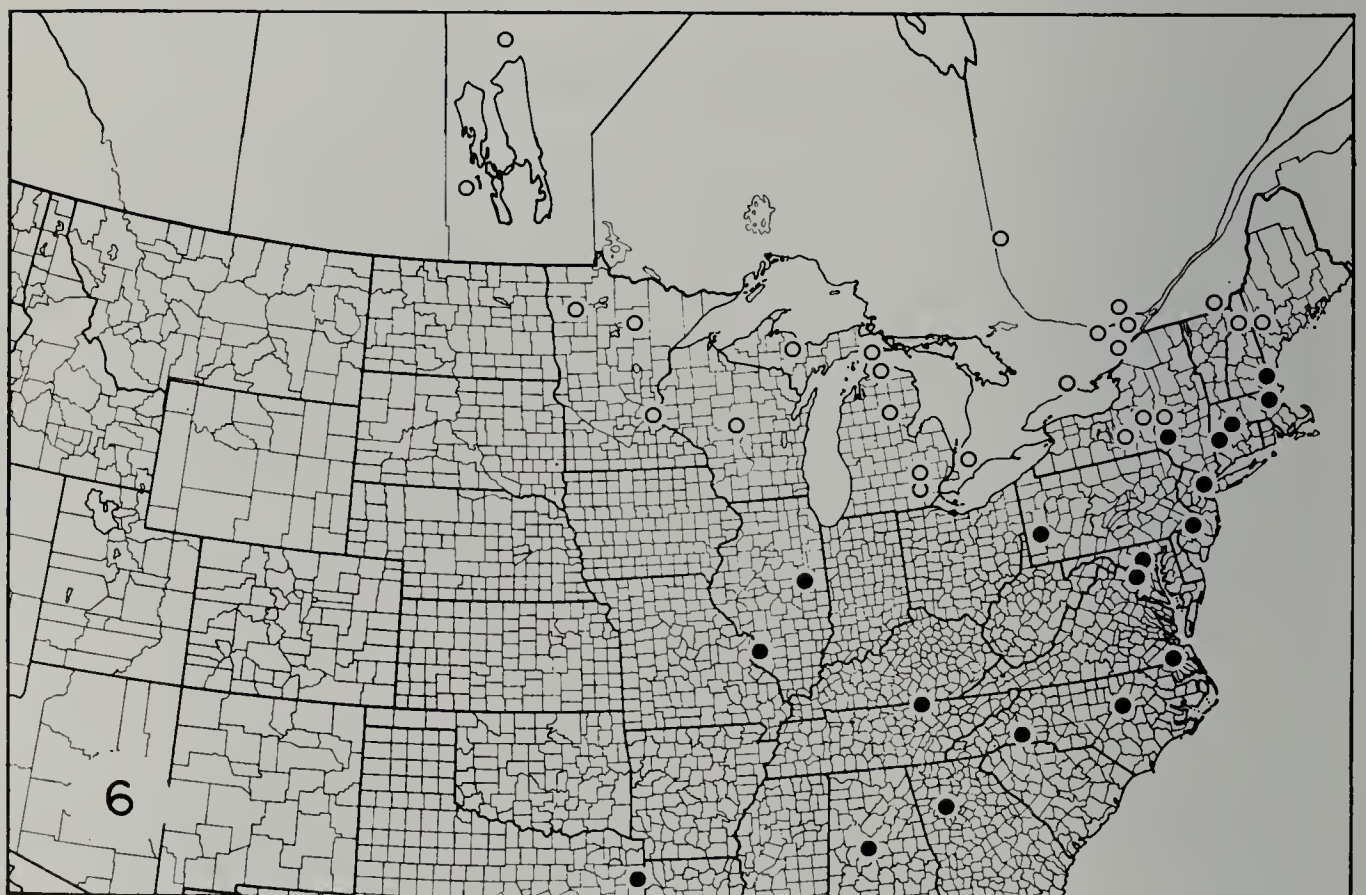
Pyractomena angulata (Say)

For distribution see Map 1. This species was seen in nearly every locality visited during the extensive *Photinus* investigation. Usually only one or two males were seen at one time. These flew 2-15 meters above the ground, usually at the tips of tree branches, with winding, leisurely courses while emitting their flickering rusty-yellow flashes. The flash-pattern was a rapidly-modulated emission, approximately 0.8 seconds in duration at 67°. There appeared to be 9-15 modulations in each flash. Flash-pattern intervals at 67° averaged 4.3 seconds. Their rapidly modulated, distinctively colored flashes made *angulata* easily recognizable.

I was unable to attract males of this species to the flashlight, and I failed to find either dense breeding aggregations or females.

Pyractomena linearis LeConte (complex)

For distribution of this complex see Map 6. The marsh-pasture habitat of the species in this complex is similar to that of *Photinus ardens* LeConte (Lloyd, 1966), and one member of the complex was found with each *ardens* deme studied in the *Photinus* investigation. The season of activity was also similar to that of *ardens*, about two or three weeks in duration and ending by the third week in June.



MAP 5. Distribution of *Pyractomena borealis* (Randall).

MAP 6. Distribution of *Pyractomena linearis* LeConte complex (circles). Distribution of *Pyractomena marginalis* Green (dots).

Long-pulsed linearis: This species was observed at Oneida and Milford Center, New York. Activity began 40-50 minutes after sunset and continued for about an hour. Males flashed while flying slightly downward 1-2 meters above the ground; 20-50 centimeters were traversed during their flash-pattern, a steady emission estimated to be 0.5 seconds in duration at 66°. Mean flash-pattern interval at 63° was 5.9 seconds. Flight paths of some males consisted of a series of angularly displaced segments. During each flash-pattern they flew in straight lines; between flashes they moved laterally 1-2 meters and rotated a few degrees. As a result during the next flash-pattern they scanned a different area.

Several females were found in the grass within 1 meter of the ground. They responded to male and flashlight flashes with single flashes 1 second or less in duration, at short time delays.

Attractions of males to free and caged females and to the flashlight were similar. After receiving response flashes from in front of or below them, males dropped immediately to the ground, usually within 1 meter of responding lights.

4-pulsed linearis: This species was observed at McLean Bog, McLean, New York. Activity began about 50 minutes after sunset. Male flight paths, including angular displacement, were similar to those described for long-pulsed *linearis*. Male flash-patterns were similar to those described for *P. dispersa* (Lloyd, 1964). Flash-pattern interval at 60° averaged 5.1 seconds

Females were found on grass stems within 1 meter of the ground; they answered male and flashlight flashes with 4- or 5-pulsed emissions, similar to those of males, at short time delays.

Male approaches were similar to those described for long-pulsed *linearis* and *dispersa*, in contrast to those described for *borealis* and *Photinus* species.

Delayed-linearis: On July 12, 1963, considerably later than the season for the two previously discussed members of this complex, three males emitting flashes similar to those described for long-pulsed *linearis* were seen at the 4-pulsed *linearis* site at McLean, New York. One responsive female was found in the grass. She emitted single-pulsed responses approximately 1 second in duration at an average delay of 1.4 seconds (stop-watch) at 58°. This is possibly a third species in the *linearis* complex, considering that (1) female delay was much longer than that of long-pulsed *linearis*, and (2) long-pulsed *linearis* had never been observed in this site during several nights of early summer observation.

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NOTES ON HYPERA MARITIMA (TITUS). (COLEOPTERA: CURCULIONIDAE)

At present this species is known to occur only in Massachusetts: it was originally described from Nantucket Island, Martha's Vineyard Island, and Chatham. The late C. A. Frost collected several specimens at Harwich Port, which like Chatham is located on the Nantucket Sound side of Cape Cod.

Investigation at Harwich Port resulted in the discovery of three adults in early July; the following year larvae were found in early June feeding in the buds of Beach-Pea, *Lathyrus maritimus* (L.) Bigel according to Gleason (1958, The new Britton and Brown illustrated flora . . .) or *L. japonicus* Willd. according to Fernald (1950, Gray's Manual of botany, 8th ed.). Adults were reared from the larvae.

The host plant is widely distributed in the cooler parts of Eurasia and North America according to Gleason. In view of this Mr. R. T. Thompson, British Museum (N. H.), conducted a brief, preliminary study of *H. maritima* and is of the opinion that it is distinct from the European *Hypera* in the British Museum; I am grateful for his aid.

The existence of a species of *Hypera* apparently native to the United States and with such a singularly limited distribution as *H. maritima* is of great interest. This work was aided by grant GB 1442 from National Science Foundation.—D. G. KISSINGER, *Atlantic Union College, South Lancaster, Mass.*

BEETLE TALK

The following proposals concerning the scientific names of beetles were placed before the International Commission on Zoological Nomenclature:

Trypetesinae and Trypetesini (Lacordaire): Proposed emendation of family-group names under the plenary powers (Insecta, Coleoptera). By C. W. Sabrosky and E. C. Zimmerman, 1966, Bull. Zool. Nomenclature 23(1): 46-47.

Galerita Gouan, 1770 (Pices): Proposed addition to the Official Index together with addition of *Galerita* Fabricius, 1801, to the Official List. By H. Reichardt, 1966, Bull. Zool. Nomenclature 23(1): 60-61.